IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.:	09/639,912
Filing Date:	August 16, 2000
Applicant:	Bengeult et al
Group Art Unit:	2614
Examiner:	Shang, Annan
Title:	Method And Apparatus For Bi-Directional Data Services And Live Television Programming To Mobile Platforms
Attorney Docket:	7784-000129

Declaration under 37 C.F.R. § 1.131

I hereby declare under penalty of perjury as follows:

That I am a co-inventor of the subject matter of U.S. patent application Serial No. 09/639,912, filed August 16, 2000 (the "'912 application").

That the subject matter of the '912 application was conceived prior to Sept. 17, 1997, the filing date of U.S. Patent No. 5,973,647 to Barrett et al. (hereafter the "Barrett et al patent"), as evidenced by the document entitled "Wireless Aircraft Communicator", attached as Exhibit A. This document was created prior to September 17, 1997; its date of creation has been blacked out on page 1 for confidentiality purposes.

That diligence was exercised from just prior to Sept. 17, 1997, as illustrated by the document entitled "Phased Array Communication Antenna System (PACAS) Description Document" (attached as Exhibit B). The document of Exhibit B evidences that work was on-going in the development of the antenna system which is a component of the system set forth in the '912 application, from September 1997 through July of 1998.

That the subject matter of the '912 application has never been abandoned, suppressed or concealed.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true;

and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 the United States Code, and that such willful false statement may jeopardize the validity of the application, and patent issuing thereon, or any patent to which this verified statement is directed.

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EXHIBIT
A

PENGAD-Bayonne, N.J.

Demonstration and
Communication System
Architecture Description

2-1160-96DV-009-1

Wireless Aircraft Communicator (WAC)

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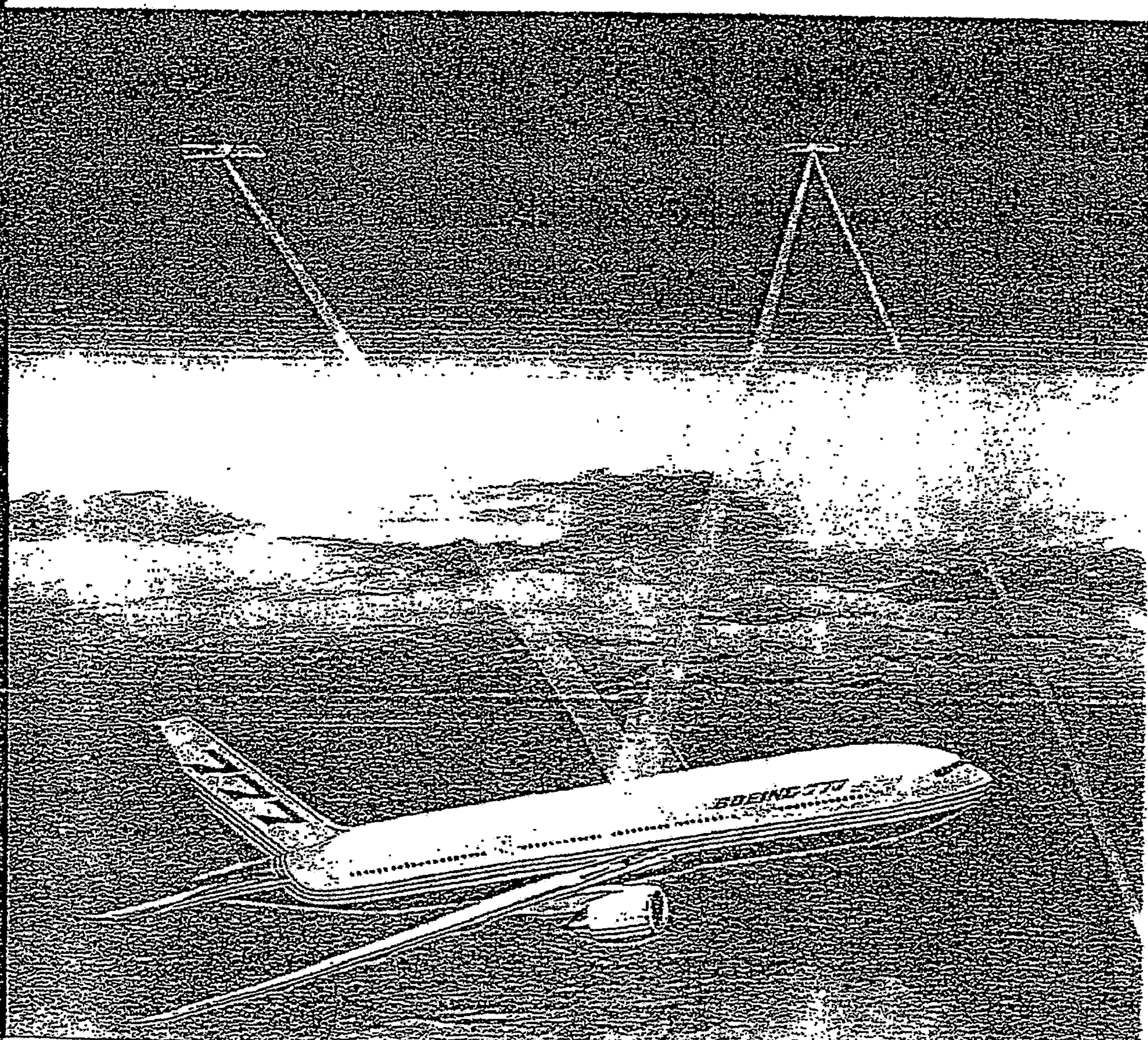

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[redacted]

Wireless Aircraft Communicator (WAC)

Demonstration and Communication System Architecture Description
2-1160-96DV-009-1

[redacted]

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ACRONYMS

A/C	aircraft
BCSC	Boeing Commercial Space Company
BIT	built-in test
BSS	broadcast satellite services
CDI	Computing Devices International
CDMA	code division multiple access
CONUS	Continental United States
COTS	commercial off the shelf
DBS	direct broadcast satellite
FACTS	flight attendant comments tracking system
FOQA	flight operations quality assurance
FMS	flight management system
FSS	fixed satellite service
IFE	inflight entertainment
INS	inertial navigation system
IRS	inertial reference system
ISDN	integrated services digital network
JWID	Joint Warrior Interoperability Demonstration
LNB	low-noise block
MB	megabytes
MMIC	monolithic microwave integrated circuit
MTBF	mean time between failure
N/A	not available
POTS	plain old telephone service
RF	radio frequency
TCP/IP	transmission control protocol/internet protocol
TDM	time division multiplex
UHF	ultra high frequency
USSB	United States Satellite Broadcasting
WAC	wireless aircraft communicator

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1.0 INTRODUCTION

Boeing Commercial Space Company (BCSC) is pleased to have the opportunity to respond to the Delta Air Lines vision for improving customer services.

The BCSC response to the Delta tenders principally addresses the Wireless Aircraft Communicator (WAC) tender Nos. 14-95, sections 3.0 and 5.0, 12-95, section 1.7.1, and 13-95, section 1.5.1. Our system concept would interface with the Delta fleet wireless aircraft communicator onboard equipment and the Delta-TransQuest ground systems.

BCSC is also responding to the Delta requirement for aircraft reception of live television, as applied to Distributed Entertainment applications to wide body aircraft under tender No. 12-95, section 1.4. While not specified by Delta for application to the narrow body fleet, this capability could interface with existing and proposed Inflight Entertainment system distribution architectures for narrow body-type aircraft.

BCSC intends to support any teaming/partnership Delta selects for both aircraft systems integrator/WAC suppliers and coordination with inflight entertainment (IFE) suppliers (tender No. 14-95, section 4.0). We have already offered a nonexclusive agreement to Honeywell/CDI for application of the BCSC-developed satellite communication system in response to the Delta requirements. We also intend to support Delta and the selected systems integrator in the fleetwide installation and integration of the proposed aircraft-to-ground communications system.

BCSC will support a Delta prototype in-service evaluation on one aircraft (narrow or wide body) in the timeframe proposed in section 3.3 with Boeing prototype aircraft communication equipment (nonblack label). The in-service performance evaluation will be subject to a contract to be negotiated with Delta within 1 month of award.

1.1 Delta Air Lines Vision for Wireless Communications

BCSC understands that the Delta initiative for improving customer satisfaction primarily focuses on the key "touch points" between Delta personnel and the passenger from ticket reservation to airport terminal gate departure/arrivals and inflight services. Consumers today are experiencing an information explosion through such sources as the Internet, electronic mail, multimedia services, and teleconferencing, and versatile and interactive entertainment using high-quality digital audio and television. Customer expectations for improved airline entertainment and inflight services are increasing. Delta's main objective is to bring the information environment to the passenger with less workload to ground and flight service personnel, while improving data management efficiency. Other objectives are to provide more versatile and interactive cabin management and inflight entertainment service and to standardize and consolidate all airplane "nonessential" information in the wireless aircraft communication system for narrow and wide body fleets.

Achieving these objectives requires a new Delta communications system architecture, as illustrated in figure 1.1-1, which addresses two-way operational and passenger services and live video for inflight entertainment. This vision translates into the data requirements shown in figure 2.1-2.

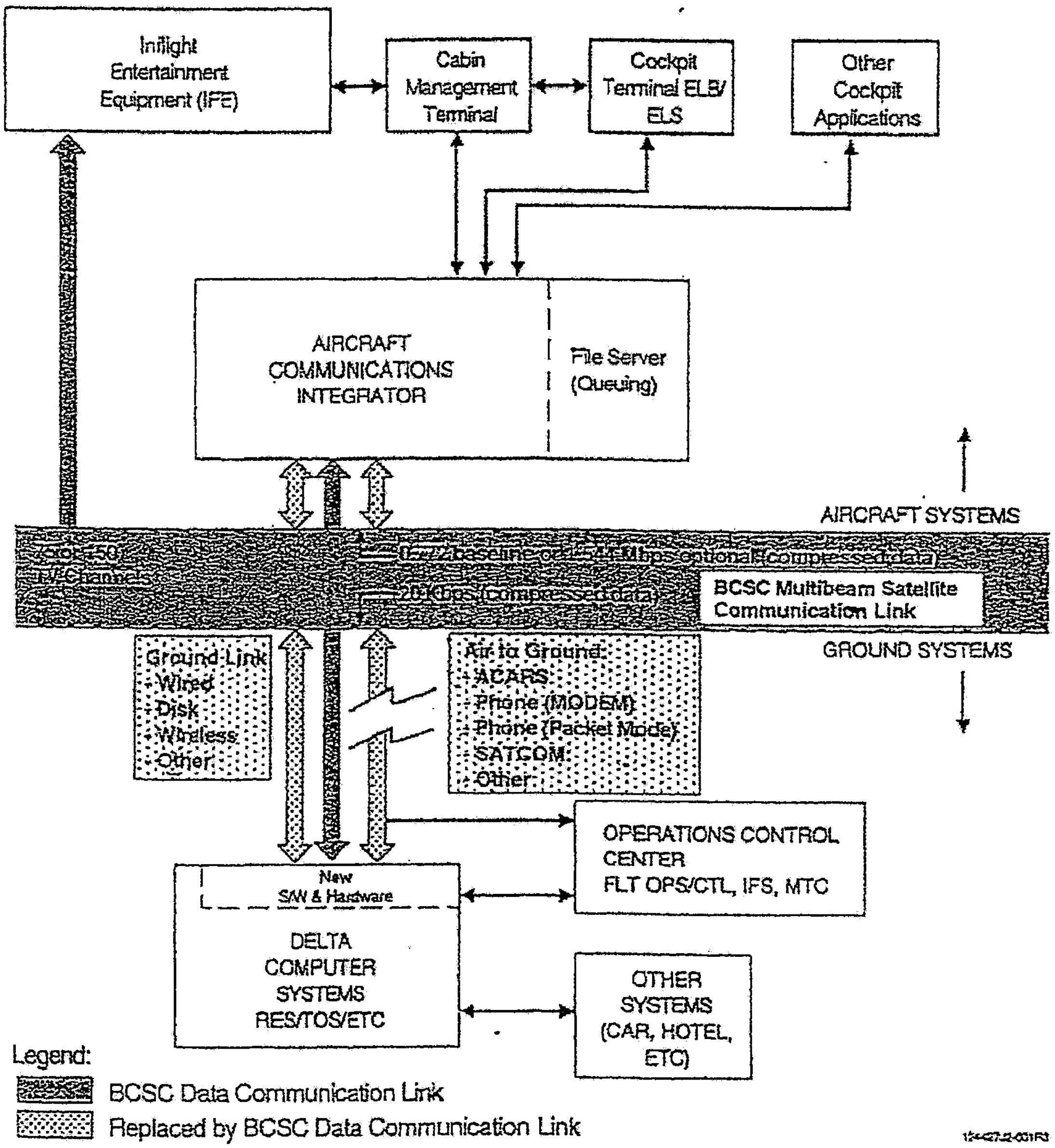

Figure 1.1-1. Delta Air Lines System Architecture

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The Communications Problem. Current communication channels serve these data requirements poorly, if at all, offering only a small fraction of the desired rate of data distribution through existing airborne unrelated systems. High-rate data can be passed through the Gate Link system, but only when the aircraft is physically connected to the gate. Because it requires transmit/receive equipment at every gate, the capital expense associated with Gate Link is formidable, if not prohibitive. Over-the-horizon wireless links, such as ACARS and UHF SATCOM (Inmarsat), offer inflight communications, but with a very limited data rate and at very high cost per bit. Terrestrial radio frequency (RF) telephone links are expensive, unreliable, and limited to the continental United States (CONUS). Satellite television is becoming a reality, but cannot be incorporated in any of the above systems, and thus requires a separate antenna installation.

The ideal solution, which BCSC is able to offer, would be an over-the-horizon wireless system with adequate band width for expandability and low cost, with the ability to accommodate two-way communications between Delta hub operations and the aircraft fleet through one data link and service provider and one antenna system per airplane. This same antenna would enable Delta to obtain inflight television from any direct broadcast provider and provide entertainment to its passengers.

1.2 The BCSC Solution

The BCSC solution to Delta's vision consists of a multibeam satellite communication link that will provide all the desired services through a combination of fixed satellite services (FSS) and broadcast satellite services (BSS) Ku-band satellites, continuously connected to every aircraft through a single low-profile phased-array antenna. Two-way operations and passenger service communication will be provided through an FSS satellite. This concept is illustrated in figures 1.1-1 and 2.1-1. The shaded area of figure 1.1-1 illustrates the BCSC air-to-ground communication link that could replace more conventional systems listed in the dotted boxes.

BCSC will provide all FSS satellite services, receiving uplink data from Delta and transmitting downlink data back to Delta via a dedicated land line, providing Delta with 24-hour "fiber-line like" services to all its domestic aircraft. Inflight television can be obtained directly from any one of a number of providers, including DirecTV, USSB, MCI, and EchoStar.

The key enabling technology is the Boeing-unique multibeam phased-array antenna, which is capable of simultaneously tracking and communicating with both FSS (for data transmission) and BSS (for live television) satellites. Unlike conventional antennas, the Boeing antenna can track multiple satellites simultaneously, without moving parts. It has a very low profile with virtually no effect on aircraft handling characteristics and fuel consumption. Because it has no moving parts, the BCSC phased-array antenna offers low maintenance and high reliability.

BCSC offers a fully compliant, expandable turnkey solution that provides low-cost communications with minimal aircraft hardware. The system is capable of delivering ALL the data specified by Delta (fig. 2.1-2) at the requested daily rates.

The BCSC solution has potential for global coverage and capacity expansion. Because of the high bandwidth inherent in Ku-band satellite communications, the BCSC solution has adequate capacity to handle both ground and airborne data requirements and to move data at a significantly lower cost per bit than older, narrowband approaches. The worldwide availability of Ku-band satellites offers the potential to accommodate expanded data rates and extend coverage beyond CONUS. Rather than requiring a multiplicity of antennas and boxes to interface with a number of narrowband communication links, the BCSC multibeam phased-array antenna enables several different types of communications through a single low-profile antenna. The proposed combination of technology and services offers a cost-effective solution unequaled by conventional approaches.

1.3 The BCSC Team in the WAC Program

BCSC will provide the overall ground/satellite transmission services between Delta-TransQuest ground operations and the Delta aircraft fleet and will provide the aircraft antenna system that will interface with the Delta wireless aircraft communicator onboard equipment. See attachment A for company organization and related experience.

~~BCSC will be responsible for providing—~~

a. ~~Message delivery service (including ground station operation/maintenance and lease of satellite service, interface with the WAC system integrator), and interface with Delta-TransQuest (customer ground operations at Atlanta),~~

b. ~~Antenna system hardware/software.~~

c. ~~Support to the WAC systems integrator~~ for aircraft installation, ~~[illegible]~~

d. ~~Support to the IFE supplier for aircraft interface of live television with the onboard entertainment system.~~

BCSC assumes that Delta and the selected systems integrator will provide fleetwide aircraft certification and live television programming.

[redacted]

2.0 OPERATIONAL SERVICES

Summary. Boeing has invested heavily over the past 10 years in developing low-cost, low-aerodynamic-drag, high-bandwidth, long mean time between failures (MTBF), multibeam phased-array antennas. The antennas represent critical technology for world coverage of mobile platform satellite communications applications. This antenna technology and the advances in high-power Ku satellites allow for a cost-effective high-bandwidth system that meets the requirements of the Delta WAC initiative.

The BCSC high-bandwidth satellite-based communication system described herein is designed to support the Delta vision for a WAC system that reliably and cost effectively provides continuous two-way performance throughout Delta domestic routes—in the air and on the ground. The system provides two-way data from the Delta Atlanta hub to and from each airplane 24 hours per day via a dedicated satellite infrastructure covering all of CONUS.

BCSC will support the Delta demonstration plan in the [redacted] of [redacted] using existing satellite/uplink assets available today. The applications developed for demonstration, combined with experience acquired in the demonstration, will be applied to the operational service, starting in the [redacted] of [redacted]. The dual-beam receive phased array allows immediate reception of selected entertainment services from the high-power BSS satellites while simultaneously receiving and transmitting high-rate data from a medium powered and lower cost FSS satellite. Some of the system features are itemized in figure 2.0-1.

- Single wireless link-one infrastructure
- Always available (24 hours per day)
- Communicate real-time and archival data
- Bi-directional
- High data rate, accommodates growth
- Expandable with airplane fleet
- Expandable beyond CONUS

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Figure 2.0-1. Features of BCSC Communicator Link System

The BCSC solution provides Delta with a cost-effective domestic route communications solution that is expandable to international routes over European and Asian landmass areas using existing Ku-band satellites and easily migrates to future ultra-high bandwidth satellite solutions.

2.1 System Architecture

The baseline Delta WAC system is illustrated in figure 2.1-1. Each Delta aircraft would be fitted with a BCSC multibeam phased-array antenna system. The antenna subsystem would provide three simultaneous, digitally controlled beams (two for receive and one for transmit) to (1) bring digital live BSS television to the airplane cabin, (2) receive Delta messaging, and (3) transmit Delta messaging. The message rate to each airplane in the air or on the ground is 772 Kbps simultaneous with TV reception and 1.544 Mbps without TV reception. The downlink message rate is 20 Kbps per airplane accommodated within 50 simultaneous channels (1 Mbps total). We believe this system will satisfy all Delta WAC needs—in the air and on the ground—far into the future. It provides up to 1.544 Mbps data capacity on uplink. Further, a satisfactory satellite-based solution over CONUS will facilitate a similar approach to Delta international routes, where such a system becomes the only practical alternative.

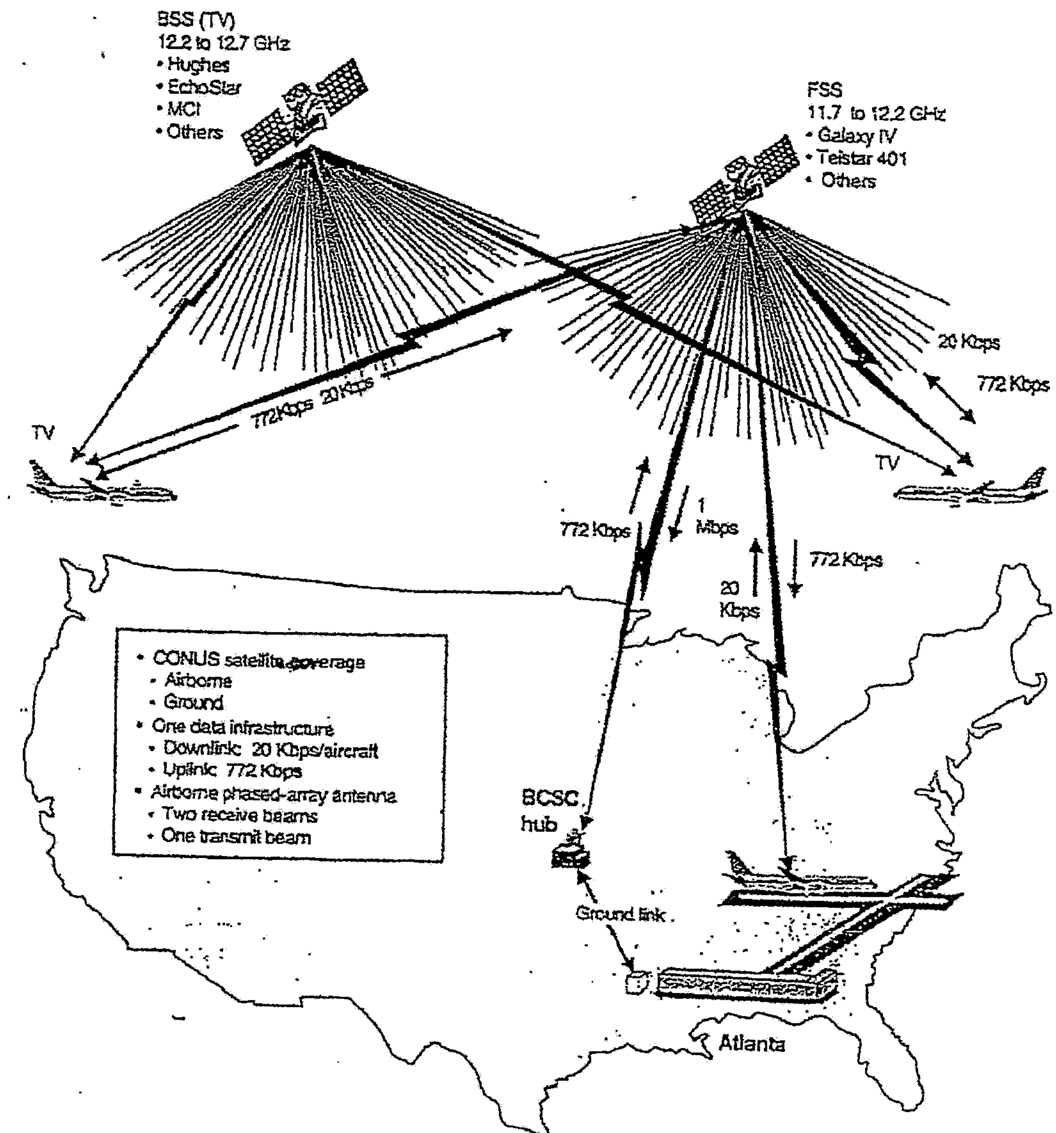

Figure 2.1-1. Proposed Wireless Aircraft Communicator (WAC)

Service Requirements. Figure 2.1-2 contains a list of Delta-specified files to be transferred to and from the aircraft along with the frequency of transmission. Most of the files are aircraft specific, one is aircraft model specific, and the rest are sent to all aircraft. The average data transmission for the fleet totals approximately 56 GB per day. By segregating the transmission into two categories, Delta suggests two message data rates for consideration: 20 Kbps at cruise conditions and 1 Mbps on the ground. The system is required to tie all of Delta's nonessential corporate airborne data communication efforts together into one central system. In addition, the WAC infrastructure will provide expandability for future applications that could be added with no hardware modifications necessary.

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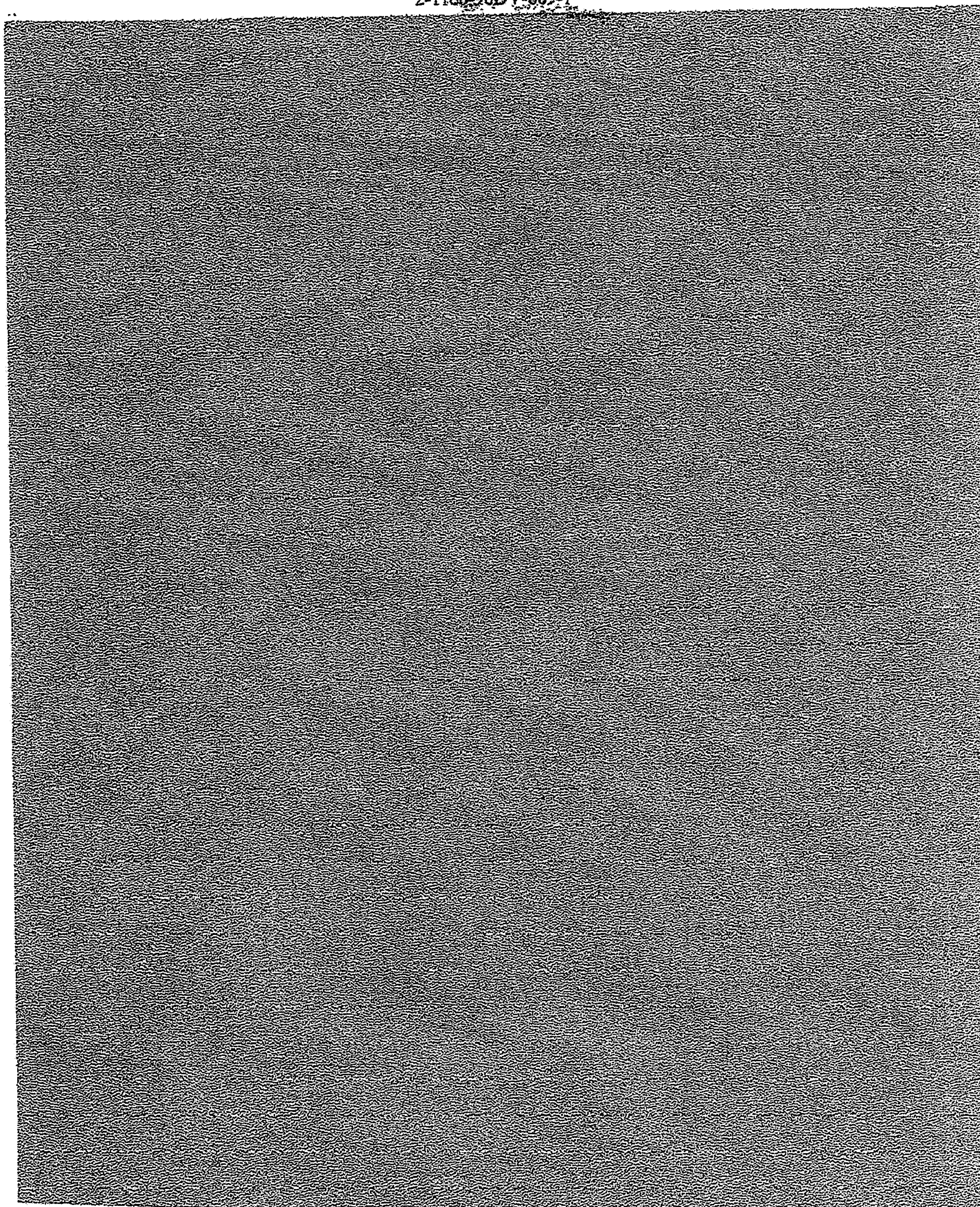

BCSC Proposed Service. The BCSC system is designed to accommodate all of the Delta requirements for communications to and from each aircraft in the air as well as on the ground in one integrated system controlled by Delta in Atlanta. A specified capacity component of the system would be dedicated exclusively to Delta. It would operate continuously and would be installed, maintained, and operated by BCSC. Our multibeam antenna installed on each Delta airplane would be connected two way to the Delta hub via satellite. The communication link is completed by a ground link between the BCSC hub and the Delta hub in Atlanta.

Fixed satellite service (FSS) (Ku-band) has been selected to provide the most cost-effective solution for data communications to and from the individual Delta aircraft. Low-cost satellite capacity is available and we exercise control over all services using the transponder. FSS satellites will be used for the demonstration and production systems. We have developed a plan to acquire the necessary licenses from the FCC for the code division multiple access (CDMA) transmission for both the demonstration and production services.

The uplink to the aircraft would be sent throughout CONUS to each aircraft in a time division multiplex (TDM) format with the aircraft address preceding each message. Each aircraft strips off only messages addressed to that particular aircraft. Common messages, such as sports scores and shopping database, would be sent in a broadcast mode using an "all aircraft" address to minimize the time allocated to such requests. The Delta tender suggests that a message rate of 20 Kbps to each aircraft is adequate. Comparatively, Boeing is proposing a much larger pipeline: [illegible] Kbps of 2:1 compressed data that is shared by all aircraft to meet the Delta requirements. This is received into the cabin simultaneously with digital TV. As an option, the system could be operated at double this message rate, to 1.544 Mbps, by foregoing TV reception.

Downlink is accomplished from the aircraft to the FSS satellite for relay to the ground station and then on to Delta using a single T-1 telephone line. An instantaneous downlink data rate of 20 Kbps was selected. Analysis described above indicates that by sharing channels using TDM the number of simultaneous channels required to support 546 Delta aircraft is approximately 50 (with 2:1 data compression). The number of channels is achieved by using different frequencies and different user codes. Boeing proposes allocating 50 channels to the Delta WAC.

The BCSC solution offers near continuous communications connectivity. Aircraft located within a maintenance hangar may be linked in a wireless manner by installing two small dish antennas external to the building. These two antennas would be wired to two small radiators in the ceiling of the hangar to relay received and transmitted signals. Interconnecting electronics consisting primarily of RF amplifiers would be required to implement hangar operation.

Our proposed system fully supports Delta's requested data flow requirements. Our analysis shows that uncompressed full data flows can be accommodated using two transponders each for uplink and downlink. We believe, however, that the best overall solution results in one transponder each for uplink and downlink and a modest data compression of 2:1. We do not believe that additional compression is desirable, as it would increase risk significantly without significantly reducing cost.

EXHIBIT B

PENGAD-Bayonne, N.J.

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DOCUMENT NO. **D909-80006-1** MODEL **PAS-F**

TITLE **Phased Array Communication Antenna System for Fairlines Hardware Interface Control Document**

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ABSTRACT

This document defines the hardware interfaces for the Phased Array Communication Antenna System for Fairlines. Connectivity and the electrical characteristics of the interfaces between the system line replaceable units (LRUs) are documented.

KEY WORDS

Airplane
Antenna
Fairlines
Interfaces
Phased Array
Receiver
Satellite
Television

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ACRONYMS AND ABBREVIATIONS

AC	Alternating Current
ARINC	Aeronautical Radio, Inc.
AWG	American Wire Gauge
BSS	Broadcast Satellite Service
dB	Decibel
DC	Direct Current
EIA	Electronic Industries Association
GHz	Gigahertz
HP	Horizontal polarization
ICD	Interface Control Document
LHCP	Left-hand circular polarization
LNB	Low Noise Block
LP	Linear polarization
LPC	Linear Polarization Converter
LRU	Line Replaceable Unit
MHz	Megahertz
RF	Radio Frequency
RHCP	Right-hand circular polarization
RX	Receive
S	Source
TX	Transmit
VP	Vertical polarization
Ω	Ohms

1. GENERAL

This document applies to the phased array communication antenna system hardware interfaces.

1.1 Scope and Purpose

This interface control document (ICD) documents the connectivity and electrical characteristics of the interfaces between system line replaceable units (LRUs). The ICD content was developed to control the system inter-LRU electrical interfaces. The ICD information represents a design implementation that complies with the Phased Array Communication Antenna System for Fairlines Requirements Document (D909-80003-1). The system external interfaces (included for reference in section 4) and the physical/mechanical interfaces (size, weight, center of gravity, and mounting provisions) are controlled by the Phased Array Communication Antenna System for Fairlines Requirements Document.

1.2 Reference Documentation

Document Number	Title
D909-80003-1	Phased Array Communication Antenna System for Fairlines Requirements Document
S909-32005	Specification Control Drawing for Low-Noise Block/Down Converter
EIA Standard RS-232-C	Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange
EIA Standard RS-422	Electrical Characteristics of Balanced Voltage Digital Interface Circuits
EIA Standard RS-485	Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems

2. SYSTEM INTERFACE INTERCONNECT DIAGRAM

An interconnect diagram is provided to show the system level connectivity for signals, power, and grounding. System LRUs are represented by solid lined boxes and external items are shown as dash lined boxes. Electrical and signal characteristics for system internal inter-LRU connections are further defined in section 3 of the ICD. System external interfaces are further defined in section 4 of the ICD.

Figure 2-1 shows the system interface connectivity including LRU and signal name identification, connector and pin definition, wire gauge (AWG), and system grounding.

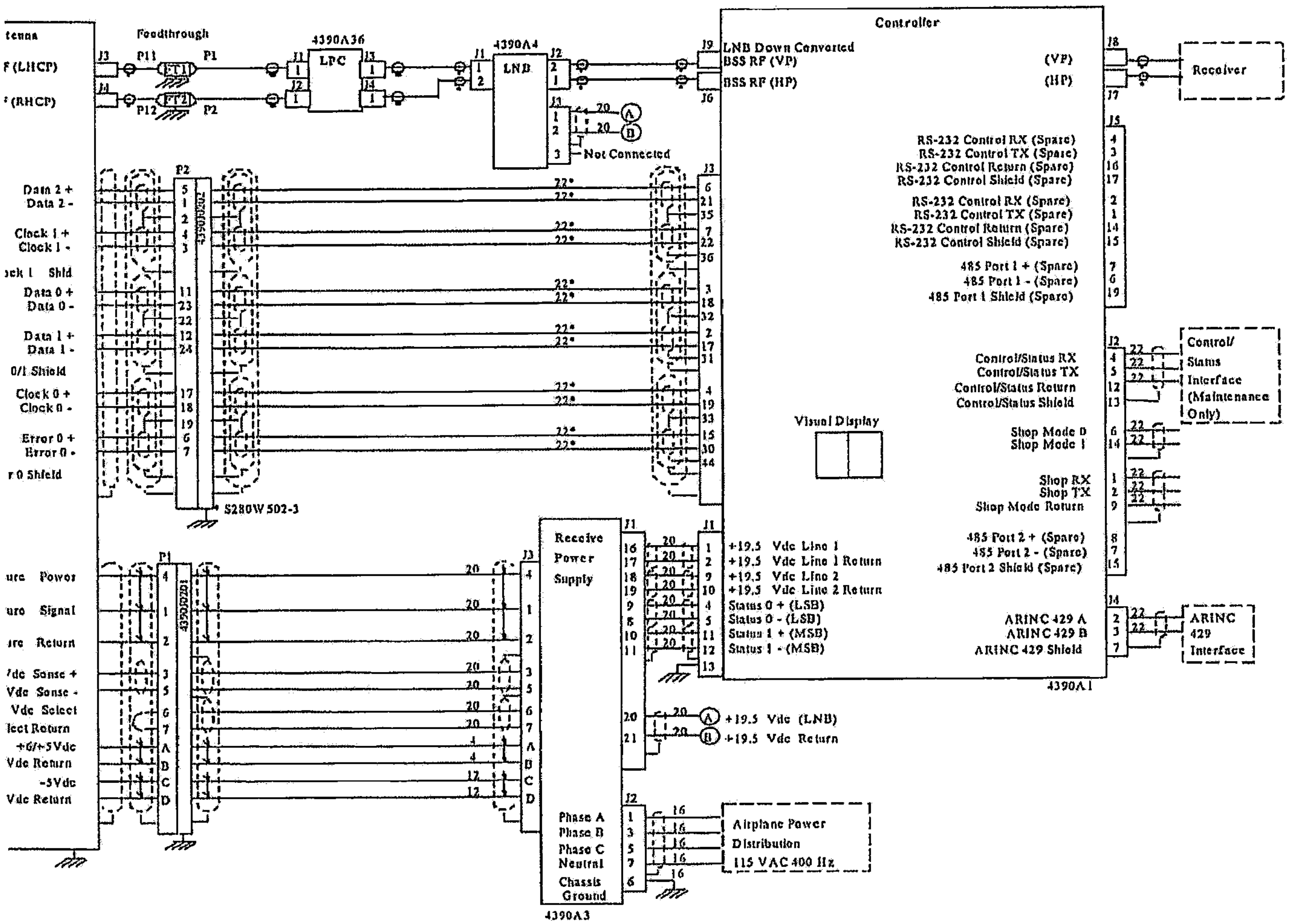

FIGURE 2-1. SYSTEM INTERFACE INTERCONNECT DIAGRAM - FAIRLINES CONFIGURATION

FIGURE 2-1 SYSTEM INTERFACE INTERCONNECT DIAGRAM – FAIRLINES CONFIGURATION

3. INTER-LRU CONNECTIVITY

The signal characteristics for the dual-polarization receive system inter-LRU connections are contained in the sections identified on Figure 3-1.

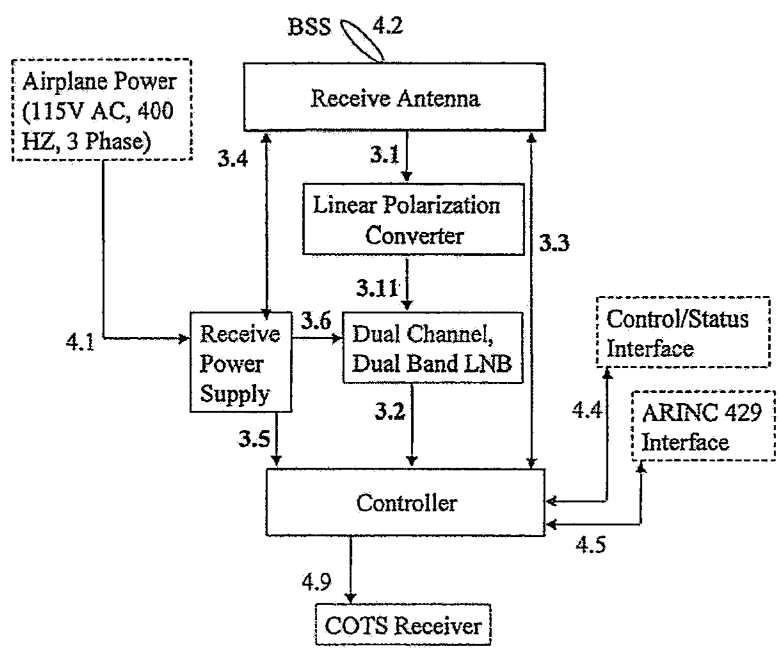

FIGURE 3-1 FAIRLINES SYSTEM INTER-LRU INTERFACE SECTIONS

Note that the "S" columns in the tables that follow stand for "Source" and a "√" means that the adjacent LRU is the signal source for the associated signal identified by the "Signal Name".

The LRU connectors are as identified in Table 3-1.

TABLE 3-1 LRU CONNECTORS

	4390A1 Controller
J1	S906-70293-291 D-Sub DA15 (Pins)
J2	S906-70293-290 D-Sub DA15 (Sockets)
J3	S906-70293-289 D-Sub DB44 (Pins)
J4	S906-70293-293 D-Sub DE9 (Sockets)
J5	S906-70293-292 D-Sub DB25 (Sockets)
J6	TNC (Jack) per MIL-STD-348 (Keyed@162°)*
J7	TNC (Jack) per MIL-STD-348 (Keyed@42°)*
J8	TNC (Jack) per MIL-STD-348 (Keyed@102°)*
J9	TNC (Jack) per MIL-STD-348 (Keyed@222°)*
	*Four gang keyed TNC connectors P/N K-4985 (Kings Electronics Co.)

	4390A2 Antenna
P1	S909-13056-002 (AE3569W25-11P)
P2	BACC63BP16C24PN
J3	SMA (Jack w/socket contact) per MIL-STD-348
J4	SMA (Jack w/socket contact) per MIL-STD-348

	4390A3 Power Supply
J1	BACC63CC24-43SN
J2	BACC63CC14-7PN
J3	S909-13056-001 (AE3560W25-11S)

	4390A4 Low Noise Block-Downconverter
J1	SMA per MIL-C-39012/60
J2	TNC per MIL-C-39012/32
J3	BACC63BV8F3PN
	Note: SMA and TNC connectors are configured per the LNB SCD (S909-32005).

	4390FT1 and FT2 Feedthrough
	Kings Bulkhead Hermetic Seal 879-13-3 or equivalent

	4390A36 Linear Polarization Converter
J1	SMA (Jack w/socket contact) per MIL-STD-348 (input LHCP)
J2	SMA (Jack w/socket contact) per MIL-STD-348 (input RHCP)
J3	SMA (Jack w/socket contact) per MIL-STD-348 (output VP)
J4	SMA (Jack w/socket contact) per MIL-STD-348 (output HP)

The system RF allocations are as identified in Figure 3-2.

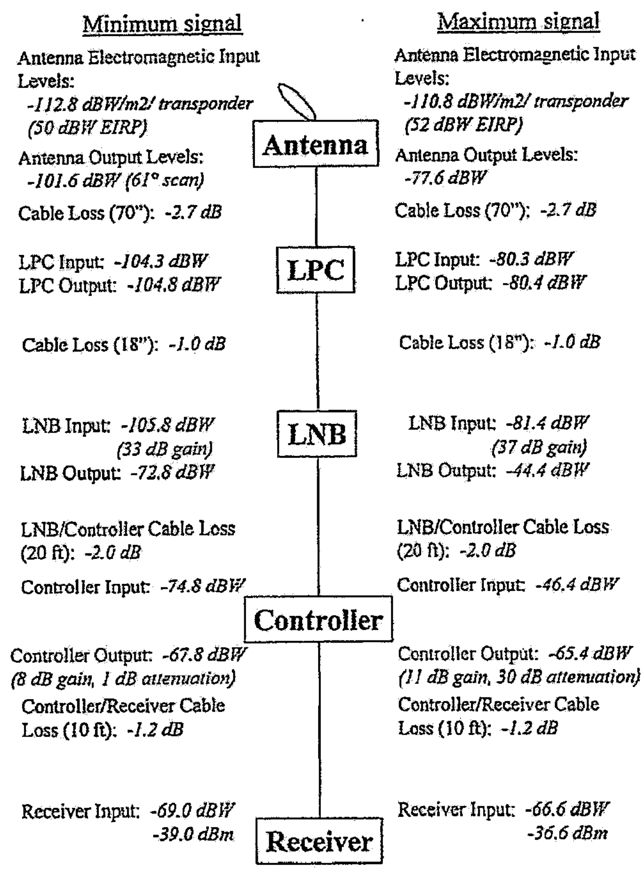

FIGURE 3-2 FAIRLINES SYSTEM RF ALLOCATIONS

3.1 Receive Antenna/LPC Interface

The receive antenna/LPC interface signal characteristics are defined in Table 3.1-1.

TABLE 3.1-1 RECEIVE ANTENNA/LNB SIGNAL CHARACTERISTICS

Receive Antenna (4390A2) Connector	S	Signal Name	Signal Characteristics	S	LPC (4390A36) Connector/ Pin Number
J3 (SMA)	√	BSS RF (LHCP)	RF Frequency Range: 11.7 to 12.7 GHz Signal Level: per figure 3-2 RF Impedance: 50 Ω		J1-1 (SMA)
J4 (SMA)	√	BSS RF (RHCP)	(Same as BSS RF (LHCP))		J2-1 (SMA)

Note that each receive antenna to LPC cable connection includes a feedthrough shown on Figure 2-1. LHCP and RHCP cables are identical length (+/- 5 millimeter). Total length from antenna to LPC is 70" ± 1".

3.2 LNB/Controller Interface

The LNB/controller interface signal characteristics are defined in Table 3.2-1.

TABLE 3.2-1 LNB/CONTROLLER SIGNAL CHARACTERISTICS

LNB (4390A4) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	Controller (4390A1) Connector
J2-2 (TNC)	√	LNB Downconverted BSS RF (VP)	RF Frequency Range: 950 to 1450 MHz Signal Level: per figure 3-2 RF Impedance: 50 Ω		J9 (TNC)
		LNB Band Select (VP)	Voltage: 10.0 to 12.0 Vdc: Convert 11.7-12.2 GHz Band 13.0 to 15.0 Vdc: Convert 12.2-12.7 GHz Band Current: ≤ 50 mA	√	
J2-1 (TNC)	√	LNB Downconverted BSS RF (HP)	(Same as LNB Downconverted BSS RF (VP))		J6 (TNC)
		LNB Band Select (HP)	(Same as LNB Band Select (VP))	√	

3.3 Receive Antenna/Controller Interface

The receive antenna/controller interface signal characteristics are defined in Table 3.3-1. The controller to antenna clock, data, and error lines are Boeing part number S280W502-3.

TABLE 3.3-1 RECEIVE ANTENNA/CONTROLLER SIGNAL CHARACTERISTICS

Receive Antenna (4390A2) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	Controller (4390A1) Connector/ Pin Number
P2-5		Data 2 +	RS-422	√	J3-6
P2-1		Data 2 -		√	J3-21
P2-2	–	Data 2 Shield	Data 2 + and Data 2 - Shield	–	J3-35
P2-4		Clock 1 +	RS-422	√	J3-7
P2-3		Clock 1 -		√	J3-22
P2-2	–	Clock 1 Shield	Clock 1 + and Clock 1 - Shield	–	J3-36
P2-11		Data 0 +	RS-422	√	J3-3
P2-23		Data 0 -		√	J3-18
P2-22	–	Data 0 Shield	Data 0 + and Data 0 - Shield	–	J3-32
P2-12		Data 1 +	RS-422	√	J3-2
P2-24		Data 1 -		√	J3-17
P2-22	–	Data 1 Shield	Data 1 + and Data 1 - Shield	–	J3-31
P2-17		Clock 0 +	RS-422	√	J3-4
P2-18		Clock 0 -		√	J3-19
P2-19	–	Clock 0 Shield	Clock 0 + and Clock 0 - Shield	–	J3-33
P2-6	√	Error 0 +	RS-422		J3-15
P2-7	√	Error 0 -			J3-30
P2-19	–	Error 0 Shield	Error 0 + and Error 0 - Shield	–	J3-44

3.4 Receive Antenna/Receive Power Supply Interface

The receive antenna/receive power supply interface signal characteristics are defined in Table 3.4-1.

TABLE 3.4-1 RECEIVE ANTENNA/RECEIVE POWER SUPPLY SIGNAL CHARACTERISTICS

Receive Antenna (4390A2) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	Receive Power Supply (4390A3) Connector/ Pin Number
P1-4		Overtemperature Power	+5±0.5 Vdc, ≤ 3 mA (SK Only) +7.5±1.0 Vdc, < 15 mA (4 mA nominal)	√	J3-4
P1-1	√	Overtemperature Signal	Overtemperature: +5±0.5 Vdc, ≥ 100KΩ Not Overtemperature: ≤ 0.1 Vdc, ≤ 150Ω		J3-1
P1-2		Overtemperature Return	Return	√	J3-2
P1-3	√	+6/+5 Vdc Sense +	Voltage*: +5 ± 0.25 Vdc or +6 ± 0.25 Vdc		J3-3
P1-5	√	+6/+5 Vdc Sense -	Current: ≤ 1 mA		J3-5
P1-6		+6/+5 Vdc Select	Short between Select and Return = +6 Vdc**		J3-6
P1-7		+6/+5 Vdc Select Return	Open between Select and Return = +5 Vdc		J3-7
P1-A		+6/+5 Vdc	Voltage*: +5 ± 0.25 Vdc or +6 ± 0.25 Vdc Current: 29 to 83 A	√	J3-A
P1-B	–	+6/+5 Vdc Return	Return	–	J3-B
P1-C		- 5 Vdc	Voltage: - 5 +5/-10% Vdc Current: 0.47 to 1.6 A	√	J3-C
P1-D	–	- 5 Vdc Return	Return	–	J3-D

*The receive power supply will provide +6 Vdc (instead of +5 Vdc) when a jumper is installed per Table 3.4-1.

**Note that the short or open of the +6 / +5 Vdc Select and Return lines is implemented in the receive antenna (anywhere between connector P1 and the antenna proper).

3.5 Receive Power Supply/Controller Interface

The receive power supply/controller interface signal characteristics are defined in Table 3.5-1.

TABLE 3.5-1 RECEIVE POWER SUPPLY/CONTROLLER SIGNAL CHARACTERISTICS

Receive Power Supply (4390A3) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	Controller (4390A2) Connector/ Pin Number
J1-16	√	+ 19.5 Vdc Line 1	Voltage: +19.5±2.0 Vdc Current: 0.53 to 0.88 A (Total for both lines)		J1-1
J1-17	–	+ 19.5 Vdc Line 1 Return	Return	–	J1-2
J1-18	√	+ 19.5 Vdc Line 2	(Same as + 19.5 Vdc Line 1)		J1-9
J1-19	–	+ 19.5 Vdc Line 2 Return	Return	–	J1-10
J1-9	√	Status 0 + (LSB)	+5V Differential, 2 Bit Code + to - : +5V = 1, -5V = 0		J1-4
J1-8	√	Status 0 - (LSB)	Status codes, as Binary-Coded Decimal (BCD) (Status 0 is Least Significant Bit (LSB),		J1-5
J1-10	√	Status 1 + (MSB)	Status 1 is Most Significant Bit (MSB)): <u>Decimal</u> <u>BCD</u> <u>Status</u> 0 00 Antenna Overtemperature 1 01 Controller/LNB Power Fault		J1-11
J1-11	√	Status 1 - (MSB)	2 10 Antenna Power Fault 3 11 No Faults		J1-12
	–	Chassis Ground	Ground	–	J1-13

3.6 Receive Power Supply/LNB Interface

The receive power supply/LNB interface signal characteristics are defined in Table 3.6-1.

TABLE 3.6-1 RECEIVE POWER SUPPLY/LNB SIGNAL CHARACTERISTICS

Receive Power Supply (4390A3) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	LNB (4390A4) Connector/ Pin Number
J1-20	√	+ 19.5 Vdc (LNB)	Voltage: +19.5±2.0 Vdc Current: 0.4 to 1.250 A		J3-1
J1-21	–	+ 19.5 Vdc Return	Return	–	J3-2
	–	Chassis Ground	Ground (For LNB Test Only)	–	J3-3
J1-BS	–	+ 19.5 Vdc Shield	Shield	–	J3-BS

3.7 Reserved

3.8 Reserved

3.9 Reserved

3.10 Reserved

3.11 LPC/LNB Interface

The LPC/LNB interface signal characteristics are defined in Table 3.11-1.

TABLE 3.11-1 LPC/LNB SIGNAL CHARACTERISTICS

LPC (4390A36) Connector	S	Signal Name	Signal Characteristics	S	LNB (4390A4) Connector/ Pin Number
J3 (SMA)	√	BSS RF (VP)	RF Frequency Range: 11.7 to 12.7 GHz Signal Level: per figure 3-2 RF Impedance: 50 Ω		J1-1 (SMA)
J4 (SMA)	√	BSS RF (HP)	(Same as BSS RF (VP))		J1-2 (SMA)

VP and HP cables are identical length (+/- 5 millimeter). Total length is 18" ± 1".

4. EXTERNAL INTERFACES

The signal characteristics for each of the external interface connections are contained in the sections identified on Figure 4-1.

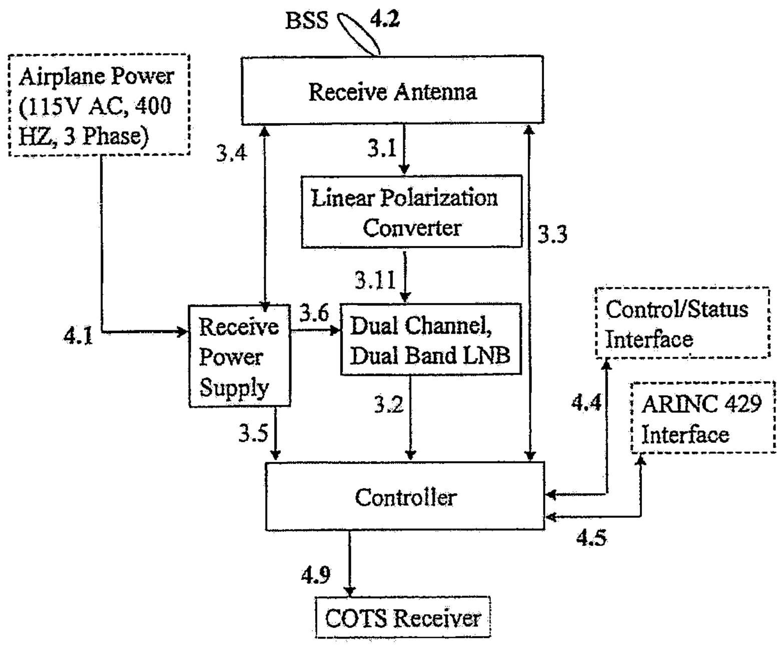

FIGURE 4-1 EXTERNAL INTERFACE SECTIONS

4.1 Airplane Power (115V AC, 400 Hz) Interface

The airplane power (115V AC, 400 Hz) interface signal characteristics are defined in Table 4.1-1.

TABLE 4.1-1 AIRPLANE POWER SIGNAL CHARACTERISTICS

Power Supply (4390A3) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	Airplane Connector/ Pin Number
J2-1		Phase A	115V AC, 400 Hz	√	P2-1
J2-3		Phase B	115V AC, 400 Hz (120 degree phase displacement from Phase A)	√	P2-3
J2-5		Phase C	115V AC, 400 Hz (240 degree phase displacement from Phase A)	√	P2-5
J2-7	–	Neutral	Return	–	P2-7
J2-6	–	Chassis Ground	Safety Ground	–	P2-6

4.2 Broadcast Satellite Services Interface

The broadcast satellite services interface signal characteristics are defined in Table 4.2-1.

TABLE 4.2-1 BROADCAST SATELLITE SERVICES SIGNAL CHARACTERISTICS

BSS Satellite	S	Signal Name	Signal Characteristics	S	Receive Antenna (4390A2)
Downlink Transmit Antenna	√	BSS Input	Electromagnetic Wave Frequency Range: 11.7 to 12.7 GHz Instantaneous Bandwidth: 500 MHz Flux: see figure 3-2[Flux(dBW/m^2) =EIRP(dBW) - 20log(Path (km)) - 71.0, where "Path" is satellite-antenna distance.] Polarization: Horizontal and Vertical		Phased Array

4.3 Reserved

4.4 Control/Status Interface

The control/status interface signal characteristics are defined in Table 4.4-1.

TABLE 4.4-1 CONTROL/STATUS INTERFACE SIGNAL CHARACTERISTICS

Controller (4390A1) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	Connector/ Pin Number
J2-4		Control/Status RX	RS-232, asynchronous 8 data bits, 1 start bit, 1 stop bit, no parity 19200 baud	√	P2-4
J2-5	√	Control/Status TX	(Same as Control/Status RX)		P2-5
J2-12	–	Control/Status Signal Return	Return	–	P2-12
J2-13	–	Control/Status Signal Shield	Shield	–	P2-13
J2-6		Shop Mode 0	TTL Levels (inputs to controller) Open = 0, Ground = 1		P2-6
J2-14		Shop Mode 1			P2-14
J2-1	√	Shop Mode RX	(Same as Control/Status RX)		P2-1
J2-2		Shop Mode TX	(Same as Control/Status RX)	√	P2-2
J2-9	–	Shop Mode Return	Return	–	P2-9
J2-8	√	485 Port 2 + (Spare)	RS-485		Not Connected
J2-7	√	485 Port 2 - (Spare)			Not Connected
J2-15	–	485 Port 2 Shield (Spare)	485 Port 2 + and 485 Port 2 - Shield	–	Not Connected

4.5 ARINC 429 Interface

The ARINC 429 interface signal characteristics are defined in Table 4.5-1.

TABLE 4.5-1 ARINC 429 SIGNAL CHARACTERISTICS

Controller (4390A1) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	Connector/ Pin Number
J4-2		ARINC 429 RX A	High = +6.5 to +13.0 VDC differential Low = -6.5 to -13.0 VDC differential Null = -2.5 to +2.5 VDC differential	√	P4-2
J4-3		ARINC 429 RX B		√	P4-3
J4-7	–	ARINC 429 Shield	Shield	–	P4-7

4.6 Reserved

4.7 Reserved

4.8 Reserved

4.9 COTS Receiver

The Controller/COTS Receiver interface signal characteristics are defined in Table 4.8-1.

TABLE 4.8-1 CONTROLLER/COTS RECEIVER SIGNAL CHARACTERISTICS

Controller (4390A1) Connector/ Pin Number	S	Signal Name	Signal Characteristics	S	COTS Receiver Connector / Pin Number
J8 (TNC)	√	Downconverted BSS RF (VP)	Frequency Range: 950 to 1450 MHz Signal Level: per figure 3-2 E_b/N_0: $\geq$ 5.8 dB Line Impedance: 50 Ω		Per Receiver
J7 (TNC)	√	Downconverted BSS RF (HP)	(Same as Downconverted BSS RF (VP))		Not connected

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